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PERS FROM THE PHYSICAL GEOGRAPHY LABORATORY OF HARVARD UNIVERSITY.

NO. 11. LIST OF GEOGRAPHICAL LANTERN SLIDES.

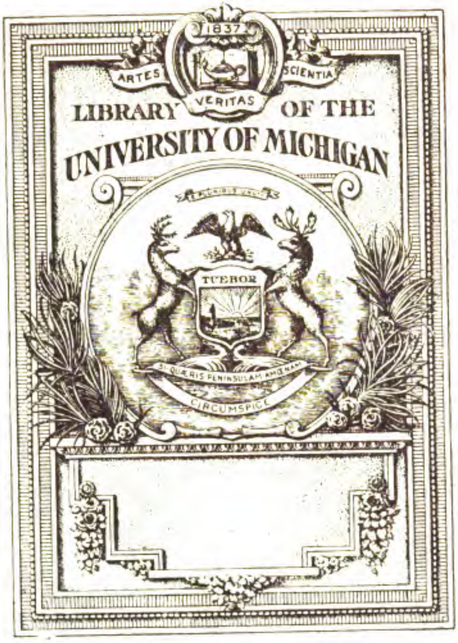
PREPARED FOR USE IN THE CAMBRIDGE PUBLIC SCHOOLS

BY WILLIAM M. DAVIS,

PROFESSOR OF PHYSICAL GEOGRAPHY IN HARVARD UNIVERSITY.

REPRINTED FROM THE ANNUAL REPORT OF THE SCHOOL COMMITTEE OF THE CITY OF CAMBRIDGE FOR 1893.

CAMBRIDGE, MASS.,
HARVARD PRINTING CO.,
1894.



THE GIFT OF
Prof. I. C. Russell

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PAPERS FROM THE PHYSICAL GEOGRAPHY LABORATORY OF HARVARD UNIVERSITY.

NO. II. LIST OF GEOGRAPHICAL LANTERN SLIDES.

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REPORT ON
GOVERNMENTAL MAPS
FOR USE IN SCHOOLS.

PREPARED BY

W. M. DAVIS,
Harvard University, Cambridge, Mass.

C. F. KING,
Dearborn Grammar School, Boston, Mass.

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A Committee of the Conference on Geography
Held in Chicago, Ill., December, 1892.

12mo, limp cloth. Price to teachers by mail, 34 cents.

The Report of the "Committee of Ten" on Secondary School Studies contains, among other contributions to this subject, the recommendations of the Conference on Geography held in Chicago, December, 1892. Mention is there made of the appointment of a sub-committee, consisting of Wm M. Davis, professor of physical geography in Harvard University, Chas. F. King, master of the Dearborn School, Boston, and Geo. L. Collie, professor of geology, Beloit College, to prepare a list of governmental maps by which the features of our country could be illustrated. The work of this sub-committee now appears in the above-named book, which may be confidently commended to all teachers of geography as a most practical guide to available means of illustration.

The contents of the book are briefly as follows: a series of preliminary suggestions, indicating the manner in which the maps can be effectively employed in teaching; the names of a large number of maps, those representing the more elementary forms and suitable for use in grammar schools being specially designated; the names of the bureaus by which the maps are published, and the address of the officers to whom application should be made for the maps; the cost of the maps, always moderate in amount, and in many cases gratis on proper application; the physical features of individual maps, such as dissected plateaus, mountain highlands, volcanic lakes, river-flood plains, meandering valleys, transverse valleys, irregular shore lines, and smoothed shore lines; and notes on the relation of geographical form to settlement, occupation, and movement.

It is believed that many teachers will be surprised at the abundance and variety of geographical material published by our governmental bureaus, as well as at the moderate cost of obtaining it. The superb map of the alluvial plain of the Mississippi River published by the Mississippi River Commission, in eight large sheets, costs but forty cents: it is simply invaluable for the study of the lower course of our great river. Single sheets exhibiting the meandering course of the river on a larger scale, like microscopic enlargements of certain parts of the smaller scale map, cost twenty cents a sheet. The elaborate charts of the Coast Survey, of which an illustrated catalogue can be obtained gratis on proper application, include the most beautiful illustrations of our shore line; the broken coast of Maine, with its outlying islands and its deep-entering fiords; the curved sand-bars and pointed capes of the Carolinas; the digitate delta of the Mississippi, and many other examples. The numerous topographical maps issued by the Geological Survey represent typical features in many parts of the country; the Atlantic coast and coastal plain; the Appalachian valleys, ridges, and plateaus; the prairies and plains of the central part of the country; the rugged mountains, the dissected plateaus, and the basins of interior drainage in the elevated western region. The publications of the Lake Survey, the Missouri River Commission, the Hydrographic Office, and the Weather Bureau are also duly mentioned.

The accounts of the various maps are prepared with the intention of emphasizing two chief points: first, the proper understanding of their physical features; second, the relation of physical features to habitation, occupation, and movement. Both of these phases of geography require much fuller illustration than they ordinarily receive before they can be clearly and fully apprehended by students, and in no direction are the material means of illustration so accessible as in the publications of the bureaus here described. It is not too much to say that the activity and enterprise of the geographical teaching in our schools will shortly come to be measured by the use made of such material aids as are set forth in this report.

HENRY HOLT & CO., Publishers,
29 WEST 23d STREET, NEW YORK.

LIST OF GEOGRAPHICAL LANTERN SLIDES

PREPARED FOR USE IN THE CAMBRIDGE PUBLIC SCHOOLS,

BY WILLIAM M. DAVIS,

PROFESSOR OF PHYSICAL GEOGRAPHY IN HARVARD UNIVERSITY.

The following list of geographical lantern slides, arranged under a rough classification, is intended to aid teachers who can illustrate their lessons by the lantern and thus present the facts of geography in the most realistic manner. The slides have been selected from at least twenty times as many views as are here represented; many of the originals being included in the Gardner collection of photographs in the geological department of Harvard University; others being in the collections of various dealers. The list is not regarded as final; various omissions may be filled at a later date; but delay in publication has not seemed advisable. In case the list is found useful to teachers elsewhere than in Cambridge, it is requested that those who have good geographical landscape views of subjects or localities not here represented, or views of striking geological structures, will send them to the author for examination, with permission to reproduce them if desired.

While some attention has been given to the localities represented by the slides and their distribution over our country, the first desire in making out this list has been to select views that should give good illustration of characteristic geographical features. Brief notes are added to call attention to the physical explanation of the more important features. Few foreign examples have been included. Twenty-five of the most desirable slides are marked by asterisks. The letters and numbers at the end of each explanatory note are explained on the last page.

Many of the classes of subjects here represented by photographic illustrations will be found represented by maps in the list of "Governmental Maps for Use in Schools," by Messrs. Davis,

[illegible]

King and Collie, lately published by H. Holt & Co., New York; an outcome of the Geographical Conference of the National Educational Association, in 1892. Teachers will find that these two kinds of illustrations supplement each other most effectively. The explanation of many of the slides, as applying to the physical geography of New England, is further extended in a pamphlet by the author, entitled "Geographical Illustrations," published by Harvard University.

PLAINS AND PLATEAUS.

Numbers 1 to 19 represent plains and plateaus, varying in conditions of origin, in degree of dissection, and in fertility. The first twelve views exhibit unbroken plains of exceptionally level surface. The later numbers illustrate the successive stages in the dissection of this group of forms; first by narrow valleys, then by wider valleys and by valley lowlands, until at last only isolated mesas and outliers remain above a broad lowland of denudation.

1. Vista near Lakewood in the great pine plains of southern New Jersey; a recently emerged sea bottom, the type of a vast area along our Atlantic border. [H.]

2,* 3. Level prairie, the "valley" of the Red river of North Dakota; formerly during a colder climate the bottom of an extensive lake, whose waters were held in on the north by the retreating ice sheet of the glacial period; now under a milder climate a fertile farming country. Many prairies of this origin are found in our northern states. The only interruptions of the horizon are houses, barns, "tree claims" (groups of planted trees), and straw stacks. No. 2, is a harvesting scene on a vast wheat field in Traill county; No. 3, shows a herd of cattle grazing in Cass county. The photographs from which these slides are made were exhibited at the World's Fair by the Commissioner of North Dakota, 1893. [H.]

4. Dry interior plain about the city of Queretaro, on the plateau of Mexico. This is the type of the desert interior plains of Utah and Nevada. Many plains of this kind were formerly lake beds, now exposed by a change from a more humid to the present arid climate. [J. 1126.]

5.* Lava plain, the unworn surface of a lava flood occupying a broad basin in southern Idaho; photographed by Prof. G. F. Wright, Oberlin, Ohio. Barren lava in the foreground; sage brush, characteristic of the dry climate of our western interior, scattered over the plain. Compare with Nos. 49, 50 and 13. [H.]

6. The plateau of snow and ice over the interior of Greenland, from a photograph taken by Nordenskiold. A broad, cold desert; of particular interest to us, from being the best modern representative of the ancient ice sheet that spread over the northern part of our country in the glacial period. The view is not a particularly fine one, but makes up for its quality by its rarity. [H.]

7. Till plain near Columbus, Ohio; photographed by Prof. E. Orton. A plain of unstratified glacial drift (till), smoothly spread out under the creeping ice sheet of the glacial period. Many prairies in the northern central States are of this kind. [H.]

8*a*, 8*b*.* Flood plain of the Mississippi river, Louisiana and Mississippi; a broad alluvial plain, spread out by the great river (see 58); exceptionally fertile, producing rich crops of sugar cane (8*a*) and cotton (8*b*). [J. 1560,7446.]

9, 10. Delta plain of the Yahtse river, Alaska; photographed by Prof. I. C. Russell. This river issues from the Malaspina glacier (see 74 to 78), heavily charged with detritus, and spreads out a plain of gravel and sand. Its network of channels (9) frequently shifts from place to place. The wash of gravels may invade forests, killing the trees by burying their trunks (10). [H.]

11. Plain of glacial gravels and sands, Cape Cod, Mass.; view taken by the author, from a morainic hill on the north side of the Cape, looking south; a glacial boulder in the immediate foreground. The conditions of origin of this plain are illustrated in the two preceding slides, (see also, 78). [H.]

12. Tidal marsh, Cohasset, Mass. The quiet waters of sheltered bays (see 108), are gradually filled to the level of high tide by silt and vegetable growth; meandering channels for tidal streams being kept open across their even surface. Crops of "salt hay" are often gathered from these plains. They occupy great areas along our Atlantic coast. [H.]

13. A deep valley in the western Ghâts (escarpments) of the lava plateau of southern India. Although the development of valleys is here well advanced on the margin of the plateau, the surface further inland is very little dissected, (see also 49, 50). [H.]

14. The Llano Estacado or stockaded plain of western Texas, from a photograph by Prof. R. S. Tarr, Cornell University. This plateau is so called from being rimmed on nearly all sides by descending cliffs, where the upland surface descends to lower levels. The view shows only the broad unbroken plateau, where it is not yet dissected by the erosion that has formed the encircling cliffs. [H.]

15.* The valley of the Blackwater in the forest-covered Appalachian plateau of West Virginia. The extensive upland is well dissected by deep, narrow, ramifying valleys, producing a surface of strongly varied relief. Compare with the canyon of the Grand river, (44,) and of the Colorado, (46). [J. 131.]

16. The valley of the Elbe at Schandau in the plateau of Saxony, Germany; a well opened valley, showing the beginning of a narrow flood plain (see 58); thus introducing belts of lowland between the remaining plateau uplands. [McA. 6806.]

17.* The Great plains of the west, here shown with a rolling, treeless, grassy surface in North Dakota. A large flock of sheep in the foreground. A distant view of the plains from the mountains is given in No. 24. [H.]

18. The Great plains of the west, here shown with sparse vegetation in the dry climate of eastern Montana. A large herd of cattle in the foreground. A few cottonwood trees by a small stream in the distance. A mesa rises in the background, one of many remnants of a once much more extended plateau, now greatly consumed by the branching and widening of valleys and by the wasting and retreating of cliffs. Isolated forms of this kind are used as citadels by the Zuñi Indians; one is used as a "state prison" in Abyssinia.
[McA. 42, Montana, Cattle ranche.]

19. The "Lighthouse" outlier, central Wisconsin; one of the isolated remnants of an ancient upland, now almost completely consumed by long continued erosion, leaving a broad, open lowland of denudation. [H.]

MOUNTAINS.

Nos. 20 to 30 represent high mountains of still vigorous form; 20 to 25 being examples from the Rocky mountains of Colorado. 31, 32, and 33 are older mountains of moderate altitude, presumably much reduced from their former height. 34 and 35 represent mountains that were once high; that were slowly worn down lower and lower till they were reduced to a lowland; the lowland was then raised evenly to an upland or plateau, and valleys were eroded in its uplifted surface: the present even-topped mountains or highlands are the little-worn parts of the uplifted lowland.

20.* Long's peak, Rocky mountains; a characteristic view of the snow-patched mountains rising over one of the open valleys, known as Estes park. [J. 361.]

21. Sultan mountain; a well defined mountain mass, descending into deep valleys. [J. 186.]

22. Gray's peak; exhibiting the comparatively regular, graded slopes to which many of our western mountains are reduced; the lower stretches of the slopes are forest clad; the upper stretches are long inclines of loose, barren rock-fragments. [J. 1152.]

23. Mt. Ouray and Marshall pass. This mountain exhibits still better than the preceding one the prevalence of graded slopes of loose rock and soil, characteristic of a dry climate. Where the rainfall is greater, the slopes are better washed and show a greater variety of form. The line of the Denver and Rio Grande railway may be seen, curving around the spurs on its way to Marshall pass, in the distance at the left base of Mt. Ouray. [J. 1426.]

24. Timber line on Pikes peak. The upper limit of tree growth is here shown on the evenly graded southern slope of the mountain. The slope consists of loose rocks, weathered from the mountain mass and slowly creeping down the mountain side. The view looks east over the Great plains, which stretch to the horizon, as even as the ocean. [J. 1223.]

25. Georgetown, Colo., a mining town in a deep valley among the mountains. [J. 1033.]

26.* Mount St. Elias, as seen from the Malaspina glacier, looking northward; photographed by Prof. I. C. Russell. Being of great height and close to the ocean, the mountain is heavily snow-clad, and with its fellows yields great streams of ice or glaciers that creep slowly to the sea (see also, Nos. 74 to 78). [H.]

27,* 28, 29. Yosemite valley, Sierra Nevada mountains, California. No. 27, a general view, looking east; 28, El Capitan; 29, the South or Half Dome. This valley is a great depression beneath the mountainous upland, enclosed by stupendous cliffs of granite. [J. 1330, 1332, 1338.]

30.* Mt. Blanc, Alps of Savoy; view taken from the Brévent, looking southeast across the deep valley of Chamounix. The glaciers des Bossons and de Taconnaz (left and right) descend in narrowing tongues from the upper snow fields; their lateral and terminal moraines are well shown on the lower slopes. [McA. 2090.]

31. White mountains, North Conway, N. H.; valley of the Saco river in the foreground. The moderate slopes of these old mountains should be compared with the steeper forms of the preceding examples. [McA. 619 N. H.]

32, 33. Adirondack mountains; often tree clad to the summits. See also Nos. 89, 90, where the lakes among the mountains are shown. [St. 66, 488.]

34. Highlands of northern New Jersey; photographed by Prof. J. E. Wolff. Plateau-like uplands of hard rocks, without peaks rising above the general level, but deeply trenched by northeast-southwest valleys that have been eroded on belts of softer rocks. Compare with Nos. 53, 54 and 91. [H.]

35. Kittatinny mountain and Delaware water gap; Pennsylvania and New Jersey; photographed by Prof. J. E. Wolff. View looking north across the great Appalachian limestone valley, to the long even-crested sandstone mountain ridge. The water gap is a transverse valley, cut across the mountain by the Delaware river. The weaker rocks on either side of the mountain ridge have wasted away from as great a height as that of the mountain crest; thus being reduced to broad valley lowlands, while only a narrow notch has been cut in the hard rocks which stand up as the even-crested ridge. [H.]

VOLCANOES AND THEIR ASSOCIATED FORMS.

This series includes a number of illustrations not ordinarily associated with volcanoes; yet properly belonging in a volcanic series.

36.* Vesuvius in eruption; a remarkable view of the great cloud formed over the volcano during the eruption of April, 1872; taken by Sommer, April 26, 1872, at 5 P. M., looking southeast across the Bay of Naples. [H.]

37. Muirs butte, Cala.; a volcanic cone of smooth slopes and hence of relatively recent eruption, rising over a broad platform covered with pine forest. [J. 1372.]

38.* Mt. Shasta, Cala.; a great volcano, scored with ravines radially descending its slopes; hence it may be inferred that a considerable time has elapsed since its building. [J. 1326.]

39. Mt. Hood, Or.; like the preceding, but more deeply dissected, showing little if any of its original conical slopes; bearing more snow from being in a somewhat moister and colder climate. The view shows a beautiful reflection of the peak in Lost lake. [J. 1378.]

40. Ropy lava flow, Hawaii; a comparatively smooth lava surface, characteristic of flows that remain unbroken after first solidifying; locally called "pa-hoe-hoe," in contrast to the rough fields of loose angular fragments, called "a-a," that are formed where continued movement breaks the first-formed crust into sharp clinkers. [H.]

Nos. 5, 13, 49 and 50, mentioned elsewhere, exhibit extended lava plains, the outpourings of great eruptions, more or less dissected.

It is uncertain whether volcanic cones were formed when the lava of these plains was erupted; or whether their lava rose through fissures that are now buried.

41.* Mato-tepe, Wyo.; photographed for the U. S. Geological Survey by Prof. I. C. Russell. The "stock" or root of an ancient eruption. This great column is the filling of a tube, up through which the lavas rose from unknown depths beneath to unmeasured heights above the present surface; perhaps overflowing on the then surface of the region. But since then, the region has been greatly denuded; and, as the country rock is weaker than the lava core, the latter has withstood erosion effectively enough to gain a strong relief above the surrounding surface. Such buttes as this are not uncommon in the west, although few of them have so bold a form. • [H.]

42. Palisades of the Hudson. The edge of a great sheet of lava, that was driven between the under and overlying strata of sandstone. The whole mass of bedded rocks and lava has been tilted so that the strata now slant to the west; the underlying and overlying sandstones, being weaker than the lava sheet, have been worn away, leaving the resistant lava as a ridge. The view shows the palisaded or columnar structure of the lava on the eastern face of the ridge, and the talus descending to the river. The back or western slope of the ridge descends gently to the valley of the Hackensack in northern New Jersey. [McA. 282.[

43. Monarch Geyser, Yellowstone Park, Wyo. A distant view of the geyser in eruption, exhibiting its position in a depression in the forest-covered upland. The region is a lava plateau, and the geysers are attributed to the lingering heat of the deep buried masses. [McA. 1949.]

RIVERS AND VALLEYS.

This series includes a variety of geographical features, illustrative of the natural history of rivers.

44. Grand river canyon, Colo. A narrow canyon, cut in a barren plateau by a river of considerable volume. Lateral ravines are beginning to dissect the canyon walls; and large amounts of rock-waste are thrown into the river at the mouth of each ravine, especially at times of heavy rain storms. Although the canyon is too narrow for an ordinary roadway, a railroad has been constructed through it. [J. 1430.]

45. Canyon del Muerte, Ariz. A similar canyon, carved by a

smaller stream. The cliffs of this canyon contain a number of "houses," once occupied as citadels by Indians. (See 122.)
(Soule, 1890 Sup. 878.]

46,* 47, 48. Colorado canyon, Ariz. This great valley, so impressive by reason of the vast depth to which it dissects the plateau, must nevertheless be regarded as only a young valley, marking the beginning of the work of the river in carrying away the land mass through which it flows. Where the rocks are resistant, the canyon walls are steep (46); where the rocks are weaker, the walls are greatly dissected by a labyrinth of colossal ravines (47, 48).
[Soule, 1890, Sup. 879; J. 3107, 6484.]

49, 50. Shoshone falls, Idaho. A lava plain, similar to that shown in No. 5, is traversed by the Shoshone or Snake river, and thus a great canyon has been cut across the plain. The views are taken at the falls, where the river leaps from a shallower to a deeper part of its trench. The upper, shallower canyon has been cut through the topmost sheet of lava; the lower, deeper canyon has been cut through both the topmost sheet and also through an earlier, under sheet. Falls commonly occur under these conditions — the cutting of a valley through hard layers of rock, whether of aqueous or igneous origin. No. 49 is taken looking down stream from above the falls; No. 50 looks up stream from below. [J. 1112, 1111.]

The valley of the Elbe, already described, (16) may be used in illustration of a more mature valley than any thus far named in the river series.

51, 52. Cataracts of the Nile. This great river, rising under the equatorial rains, has cut its valley across the great desert of northern Africa and at several points it has trenched through the horizontal beds of sandstone, of which the greater part of the desert consists, and has discovered the uneven foundation of hard rocks on which the sandstone strata were laid down. Here the deepening of the valley is delayed; here the river runs in strong rapids, especially at time of high water; these are the "cataracts" of the Nile.
[Soule, 6138; Th. 9827.]

53. Deerfield valley, Mass.; a steep-sided valley, about a thousand feet deep. This view is in the Berkshire plateau of western Massachusetts, a part of the northwestern extension of the Appalachian plateau, already represented in the highlands of New Jersey. The traveller in the valley does not perceive the general evenness of the uplands; but on ascending to the hilltops, the comparative equality of altitude, far and wide, is clearly seen. [H.]

54, 55,* 56. The Hudson river. The highlands of south-eastern New

York, a part of the Appalachian highlands extending from New England into New Jersey, are traversed by the Hudson river. It has trenched them across, just as the Delaware river has trenched Kittatinny mountain at the water gap (35). A general view of the deep Hudson valley in the plateau-like highlands, looking east from Fort Putnam (up-hill from West Point), is given in No. 54; a closer view of the great river is given in No. 55, looking up-stream from West Point. The great volume of water in the river calls for special explanation, in view of the moderate area that it drains. The upper Hudson, at Glens Falls, above Albany (56), is only a shallow stream. As the tides are felt up to Albany, it is believed that the region has been slightly depressed since the valley was cut out; thus the lower half of the river has been "drowned," giving it navigable depth, a matter of great importance to New York city. [St. 1303; J. 1515; St. 664.]

57. Gorge of the Potomac river, below the junction of the Potomac and Shenandoah at Harper's Ferry. The foreground is in West Virginia; Maryland is across the Potomac on the left; Virginia is across the Shenandoah on the right. The Blue ridge, as the Virginia portion of the Appalachian highland is called, is here traversed by the Potomac; but the river has not been "drowned," like the Hudson. Its waters are shallow, and the rocky ribs of the mountain may be seen crossing its channel in riffles. The Hudson, the Potomac and various others of our Atlantic rivers drain the great Appalachian valley through deep gorges in the Appalachian highland, furnishing excellent examples of the relation between an interior longitudinal valley-lowland and the deep transverse valleys by which the inner waters escape through the highlands. It is important to remember that the interior valley lowland has been deepened only as fast as the cutting down of the transverse valley permitted. [J. 76.]

58. Flood in the valley of the Ohio river, New Albany, Ind. An imperfect photograph — but the best now accessible — of an overflow of the Ohio river; the streets in the towns on its banks being flooded, and the people going about in boats. At these times, the muddy water lays down a deposit of fine sediment or silt, and thus builds its flood plain; a broad, flat, meadow-like plain on either side of its channel. (See Nos. 8a, 8b.) The fertility of the valley of the Nile has depended on such overflows from time immemorial. [H.]

59. The Missouri river, Belmont bend, Mo. This great river has cut a steep-bluffed trench, a mile or two wide, in the upland of the state of Missouri, and has laid down a flood plain from bluff to bluff. The current of the river, flowing against the outer bank of its curving channel, cuts away the fine soil of the plain. Various expensive engi-

neering operations are undertaken to prevent this, and to constrain the river to follow a fixed channel; often without permanent success. [H.]

60.* Mississippi river at Baton Rouge, La. The great river, whose flood plain has already been shown, (8), is pictured here in its lower course. A river steamboat is about to make a landing. [J. 7426.]

61. Grand Junction, Colo. The Grand river here has a broad valley in a barren region; but where the waters of the river can be led out in irrigating canals, the soil becomes productive; thus imitating artificially the natural overflow of the Nile, already referred to. [J. 113.]

The delta plain formed where a river enters the sea, has been illustrated in Nos. 9 and 10. Large rivers with fine detritus make flat deltas; smaller streams with plentiful coarse detritus make steeper deltas, as illustrated in the next number.

62.* Talus cone, valley of the South fork of the Stinking-water, Wyo.; photographed for the U. S. Geological Survey by T. A. Jaggar. Gulleys in the upper slope of the mountain discharge the rock waste to the lower slope in such quantity that it accumulates in great conical deposits. No constant stream is present to reduce the grade of the cone. According to the proportion of the rock-waste to the water that is discharged from the upper mountain sides, these conical deposits vary their slope; being steeper in dry regions; flatter in moist regions, where they are called alluvial fans, or deltas. According to the quantity of waste discharged and to the time during which the process has been going on, the cones or fans vary in size. In southern California, where the mountains are high and the climate dry, there are fans whose height at the apex is six hundred feet above their margin; and whose radius is ten miles. In regions of moderate altitude and plentiful rainfall, alluvial fans are inconspicuous. They may therefore be regarded as examples of climatic topographical forms. [H.]

63. Fall creek, Ithaca, N. Y.; looking westward, down the gorge to the valley at the head (south) of Cayuga lake. Glacial drift has been spread irregularly over this region, in common with the rest of the northern states, and streams are very generally diverted from their preglacial courses to new paths, on which they are now actively cutting down new valleys. It is very commonly the case that falls characterize the early stages of this process, as here shown. The water power at the manufacturing cities of Manchester, N. H., and Lowell, Mass., (121) is derived from falls of essentially this character. [St. 634.]

64. Ausable chasm, N. Y. The Ausable river, issuing from the Adirondacks, and finding its preglacial course concealed by drift, has taken a new course, on which it has cut down this deep and narrow gorge, or chasm. This is manifestly a young valley compared to more open valleys, such as that of the Elbe (16). [St. 18.]

65, 66,* 67, 68. Niagara. The drainage of the Great lakes follows new courses since the glacial period; the preglacial rivers of the region not being certainly known. The postglacial discharge of Lake Erie to Lake Ontario by the Niagara river ran across a platform which descends on the north in a cliff or escarpment, three hundred feet or more in height. Here the river first leaped in its great cataract. Since then, it has cut back its gorge (65) about seven miles to the present site of the falls (66, general view). During most of the time while the falls were receding from their original position at the face of the escarpment, there has been only a single cataract; but at present, the river is divided by Goat island, making the Canadian or Horseshoe fall on the west side (67), and the American fall on the east (68). [J. 4033, 4021; McA. 525; J. 4022.]

GLACIERS AND GLACIAL ACTION.

The great importance of ice action during the glacial period in determining many of the smaller features by which the northern states are characterized, warrants the introduction of the following views as geographical illustrations. The glaciers on Mt. Blanc have already been mentioned (No. 30).

69. Viesch glacier, Alps of Valais, Switzerland; a long serpentine ice stream, between steep mountain slopes, bearing a well-marked medial moraine. [Soule, Switz. 5836.]

70, 71. Muir glacier, Alaska; photographed by H. F. Reid. Two views of this great ice field, with its many branches among the Alaskan mountains (70), and its cliffed front where it enters the waters of Glacier bay (71); taken from an elevated point south of the glacier. [H.]

72, 73. Davidson and Taku glaciers, Alaska; smaller than the Muir glacier, but like it, entering the sea and terminating in cliffed fronts. These views are taken from the sea. [Haynes, 5010, 5012.]

The five following views are of Malaspina glacier, Alaska; taken by Prof. I. C. Russell. The condition of our northern states during the glacial period is much better represented by these views than by those from Switzerland, where the ice streams are confined to narrow valleys.

74.* Central portion of Malaspina glacier; free from morainic debris; a vast plain of ice. [H.]

75. Moraine-covered portion of the glacier. The detritus here strewn over the surface is derived chiefly from rocky spurs among the mountains that supply the snow and ice. By the melting away of the ice surface as it approaches the sea, much detritus that was before invisible becomes exposed. [H.]

76. Forest growing on the moraine of the Malaspina glacier, near its southern border. [H.]

77. Source of the Yahtse river, issuing from a subglacial channel at the base of the debris-covered frontal slope of the ice sheet. Views of the delta of this stream are given in Nos. 9 and 10. [H.]

78.* General view of the Yahtse gravel delta in the foreground; the glacial plain, with its gently sloping surface and steep sloping frontal margin, in the middle distance; lofty mountains, whence part of the ice is derived, in the background. This is an exceptionally valuable view, and of particular interest in simulating the conditions of our northern states during the glacial period, except that with us there were no overtopping mountains in the background. [H.]

The ice plateau of Greenland has already been mentioned (6).

79,* 80. Icebergs, Baffin bay, Greenland. Great masses of ice detached from glaciers that descend to the sea from the Greenland ice sheet. No. 79 shows an iceberg alone, with an excellent reflection in the quiet water; No. 80 is a larger iceberg, with the "Panther" exploring vessel in the foreground. [Black.]

81. Pack ice, Baffin bay, Greenland; ice formed on the surface of the sea, and pushed together in great fragments when moved by conflicting currents. [Black.]

82. The midnight sun of the Arctic regions; taken in Baffin bay, Greenland. A somewhat irrelevant subject, but of interest as reproduced from an actual photograph taken in an Arctic midnight. [Black.]

83. Glaciated rock surface, near Eastport, Me.; view taken by the author. The rock was rounded, smoothed and striated by the detritus that was heavily dragged over it under the ice sheet of the glacial period. [H.]

84. Glaciated summit of Mt. Monadnock, N. H.; elevation, 3186 feet; view by J. H. Ropes. Postglacial weathering has somewhat cracked and pitted the rock surface; but it still exhibits a distinctly rounded form, with glacial grooves following its lines of curvature. The great depth of the New England ice sheet can be inferred from this example. [H.]

85. Boulder of gneiss, carried from Canada into Ohio by the ice-sheet; photographed by Prof. E. Orton (see also, No. 11). [H.]

A till plain is already illustrated in No. 7. Judging from numerous borings for oil and gas in northern Ohio, the rock surface under the till plain is much more uneven than the present surface.

86. Drumlin near Groton, Mass.; photographed by G. H. Barton, Mass. Institute of Technology, for the U. S. Geological Survey. Drumlin is an Irish name given to rounded, elliptical hills of till, or unstratified glacial drift, sometimes enclosing beds of gravel. These hills are common in New England and in Wisconsin; similar but more elongated hills occur in western New York. The longer axis of the hills is parallel to the direction of glacial movement. [H.]

87. An esker in Auburndale, near Boston, Mass.; photographed by J. H. Ropes. Esker is an Irish name applied to ridges of water-worn, roughly stratified, glacial gravel; believed to have been formed in subglacial stream channels during the glacial period. Eskers are probably now forming in the subglacial channels of Malaspina glacier (see 77). [H.]

Other examples of features referable to glacial action are: Fall Creek (63), Ausable chasm (64), Niagara (65 to 68), till plain (7), Cape Cod (11), various lakes (32, 33, 88 to 91).

LAKES.

Nearly all the numerous lakes of the northern part of our country and of northwestern Europe are the result of glacial action; either in the excavation of their basins, or in the obstruction of preglacial valleys by drift. The share of the two processes is difficult to determine. Lakes of other kinds are not here represented.

88. Twin lakes, upper Arkansas valley, Colo. The valley is here obstructed by the terminal moraines of glaciers that formerly descended from the mountains during a colder climatic period. [J. 279.]

89, 90. Placid and Mirror lakes, and Upper Ausable lake, Adirondacks; water bodies lying in basins, presumably in part referable to excavation, in part to obstruction, (see also, 32, 33). [St. 79, 489.]

91.* Otter pond and Kearsarge mountain, N. H. A very suggestive view exhibiting the plateau of New England (part of the Appalachian highland, 34, 54) above which rises the isolated summit of Mt. Kearsarge; beneath which a valley has been eroded, here obstructed by drift and forming Otter pond; glacial boulders lying in the foreground. [H.]

OCEAN AND COASTS.

92. Mid-ocean view; quiet weather; steamer in the distance. [H.]

93, 94. High and low tide in bays near Eastport, Me.; photographed by the author. The rise and fall of the tide in our northeastern bays measures twenty or thirty feet; much greater than is usual on the Atlantic coast. Rapid currents are thus produced in narrow channels, and much inconvenience is caused at landings.

95, 96. Flood and ebb tide at St. Johns harbor, New Brunswick. The narrow, rocky entrance to the harbor has a rushing current, called "the Falls," as the tide flows and ebbs. Vessels usually enter and depart from the harbor near slack water, between flood and ebb tide. [St. 1374, 1375.]

97, 98. Low tide. Mud flats in the Bay of Minas, Nova Scotia (97); broad cobble beach, Bay of Fundy (98). [St. 1398, 1378.]

99.* *Mascaret* of the Seine, at Caudebec, France. As the flood tide enters the narrowing estuary of the Seine, it forms several strong waves, which rush up stream with great speed, causing almost the entire rise of tide in a few minutes. In English estuaries, as in the Severn, the rapidly rising tidal wave is called a bore. Tidal action is thus intensified in bays compared to promontories, and is therefore contrasted to wave action. [H.]

100. Waves at Cape Ann, Mass. Waves formed in the open water swing in to the shore and dash against the rocky ledges. Thatcher's island with two lighthouses in the distance. [Soule, Peabody 166.]

101. Surf at Long Branch, N. J. These heavy rollers were produced by a West India hurricane, in September, 1889, which was east of Florida at the time this view was taken. The strong storm waves swing rapidly away from the storm area, and cause a long swell of moderate height in quieter seas; but when the swell runs ashore, it creates a surf, breaking heavily in shallow water. Much sand is thus taken up from the bottom and thrown towards the shore, forming bars or "beaches," as they are called on the Jersey coast. [H.]

102. Islands south of Mt. Desert, Me. The irregular coast of Maine results from a moderate depression of a rugged land, whose valleys are now occupied by arms of the sea (compare Nos. 93, 94), whose ridges stand out in promontories, and whose isolated hills appear as islands. In marked contrast to this, the simple shore line of Texas has been formed by the elevation of the smooth sea bottom, on whose plane surface the sea rests in an even line. [St. 1245.]

103. Nara fiord, Norway. When a deep valley, enclosed by steep mountain walls, is partly submerged, the sea enters it in a narrow

arm, called a fiord. A small delta is built out into the fiord in the foreground from an unseen valley on the left. The fiords of Maine are not so deep or so strongly enclosed as those of Norway. The bays of Nos. 93 and 94 are drowned valleys; the Hudson in the highlands (54, 55) is a shallow fiord. [H.]

104. Sea cliffs, Grand Manan, N. B. The waves beat against the land and cut it away, expending their greater force on projecting headlands which are thus cut back into bold cliffs. The rocks here are old lavas, exhibiting a columnar structure (compare 42). A light house stands on the headland. [Soule, Peabody, 14.]

105. Sea cliff, Dover, England. High cliffs cut in the chalk of southern England. [Soule, England, 3905.]

106.* Sea cliffs, Grand Manan, N. B. A more general view than No. 104, showing cliffs in the middle distance, and a lagoon or enclosed bay in the foreground, shut in by a curving beach or bar. [Soule, Peabody, 4.]

107. Beach near Gloucester, Mass. The rock fragments gathered from the headlands and the sands swept in from the bottom are here thrown up in a curving beach or bar at the head of a bay or cove. The greater height of the beach than of the ground behind it is shown by the houses. The smooth outline of the beach is well fitted to receive the beat of the surf, which breaks evenly upon it. [H.]

108. Wall beach, Scituate, Mass. A long beach of cobble stones, gathered by the waves from the bottom and from the shore cliffs, which are here cut in drumlins. The cobbles are thrown up in a wall-like rampart, enclosing a quiet bay where a tidal marsh (12) is encroaching on the waters. A shore line is progressively simplified by cutting back its headlands and throwing bars across its bays or beaches. [H.]

109.* The "back" of Cape Cod, Mass. The outer or eastern side of the sandy arm of Cape Cod has been cut back by the waves into a long, even, cliffed shore; and the sands thus gathered have been swept into great bars or spits, north (Provincetown) and south (Monomoy). There is consequently no good harborage on the "back" of the Cape. This view includes a stretch of the straight beach. A three-masted schooner has been driven ashore, and a life saving party are rescuing the crew. [H.]

110. Monomoy, Mass.; the low sandy spit or bar built chiefly of sands brought from the Cape to the north and from the shoals off shore; a barren strip of sands, occupied by a few fishing houses, a lighthouse and a life saving station. [St. 1206.]